Renewable and Sustainable Energy Reviews 15 (2011) 1325–1334

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

An evaluation of the transitional Turkish electricity balancing and settlement market: Lessons for the future☆

Ercüment Camadan*, Ibrahim Etem Erten[1]

Energy Market Regulatory Authority, Muhsin Yazıcıoğlu Cad. No: 51/C Yüzüncü Yıl, Ankara, Turkey

ARTICLE INFO

Article history:
Received 4 August 2010
Accepted 14 October 2010

Keywords:
Turkey
Electricity wholesale market
Balancing market

ABSTRACT

Balancing and settlement market is a crucial part of restructured Turkish electricity market. In this framework, the main purpose of this study is to examine whether the prices constituted in the transitional balancing and settlement market reflect the real cost of imbalances. Although it is observed that the prices are not powerful in indicating the real cost of imbalances, Turkey has the opportunity to form a well-functioning market within the context of planned new market structure. Turkey needs to define a proper roadmap reckoning the points mentioned in this paper to be able to achieve her objectives.

Contents

1. Introduction

Since the adoption of a reform process in late 1980s many countries all over the world have embraced liberalization, privatization and restructuring of electricity industry instead of an industry formed by vertically integrated companies. Although the motivations for the restructuring of the industry vary across the countries, the fundamental purpose is to improve efficiency of the sector through the introduction of competition among players [1]. However, the driving forces behind the reform differ between developed and developing countries. The main aim of the restructuring of the electricity industry in developed countries is to improve economic and financial performance of technically reliable systems. On the other hand, some factors such as the burden of subsidies, low service quality, high network losses, poor service coverage and, most importantly, macroeconomic problems in the countries are the reasons for the reform process in developing and transition countries [2].

Within the reform process, the regulations focused on privatization of electricity generation facilities, separation of vertically integrated monopolies, unbundling, foundation of independent regulatory authorities and allowing consumers to choose their sup-

☆ The authors work as energy experts in Energy Market Regulatory Authority of Turkey. The views and conclusions in this article do not represent the views of any institution they are affiliated with. They are entirely those of the authors.

* Corresponding author. Tel.: +90 312 2014223; fax: +90 312 2014200.
E-mail addresses: ecamadan@epdk.org.tr (E. Camadan), ierten@epdk.org.tr (I.E. Erten).
[1] Tel.: +90 3122014173.

1364-0321/$ – see front matter
doi:10.1016/j.rser.2010.10.010

pliers. Many of these policies are recommended and defended by International Energy Agency (IEA) [3].

Turkey, one of the fastest growing power markets all over the world since 1980s, is geographically located in close proximity to 71.8% of world's proven gas and 72.7% of oil reserves. Thus, it forms an energy corridor between energy source countries and main energy consumer markets. In this regard, it is apparent that Turkey is a significant country for Europe in ensuring energy security through diversification of supply resources and routes [4]. Besides, since October 2005 Turkey has passed many significant steps to be a member of the European Union (EU). In accordance with its aim to be a full member of EU, Turkey has initiated an electricity sector reform program. Within this context, the Electricity Market Law (EML)[2] was enacted in 2001. Even if many foresights of EML have not been acquired yet it has been an important step for Turkish electricity market.

The balancing and settlement market is a vital part of restructured Turkish electricity market. It is the spot market where balancing of the system is realized and spot prices are constituted. Even if there are many studies on Turkish electricity market as a whole, there are limited studies focusing on functioning of the balancing and settlement market. Hence, one of the aims of this study is to put an end to the lack of studies on this market. In addition, this study focuses on the prices in that market and investigates whether they reflect the real cost of imbalances.

This paper is organized as follows. Section 2 presents a brief introduction of Turkish electricity market. Section 3 provides a presentation of Turkish balancing and settlement market. The prices constituted in balancing and settlement market are analyzed in Section 4. The policy recommendations and concluding remarks are drawn in Section 5.

2. Turkish electricity market

2.1. Market structure

In Turkey, the first electric generator was installed in Tarsus in 1902. It was a 2 kW dynamo connected to the water mill. The first bigger power plant was installed in Silahtaraga, Istanbul in 1913 [5]. Since then, there have been some trends sometimes promoting liberalization and encouraging participation of private sector and sometimes increasing the weight of the government and nationalization of entities. These trends and developments of the industry are broadly discussed in [5–9]. Hence, the history of the market is not delineated in this paper.

However, 2001 is an important year for Turkish electricity market. EML was enacted in this year. This law aims to ensure the development of a financially sound and transparent electricity market operating in a competitive environment under provisions of civil law. An independent regulatory authority (Energy Market Regulatory Authority – EMRA) was established whose board is independent in its decisions relating the market. With the adoption of EML, private sector has acquired the right to participate in market activities such as generation and wholesale activities by obtaining a license from EMRA. The main purpose of EML is to design a bilateral contracting market complemented by a balancing market for the imbalances emerged in real time.

In the current market structure, electricity transmission activities are conducted by state-owned Turkish Electricity Transmission Co. (TEIAS). TEIAS is the sole company for the transmission activities. TEIAS also prepares, revises and inspects the transmission, connection and use of system tariffs that are subject to the Board approval. Besides, it performs load dispatch and frequency control, carries out substitution and capacity expansion activities in the transmission system, monitors real-time system reliability, purchases and provides ancillary services under the provisions of ancillary services agreements.

Regional distribution companies perform distribution activities in regions indicated in their licenses. According to EML, if a consumer is unable to purchase electricity and/or capacity from a supplier in the region served by any distribution company but the regional distribution company, the latter is obliged to obtain a retail sale license and engage in electricity sales to such a consumer on a retail basis and/or provides retail sale services. In fact, there are not any retail sale companies except for distribution companies having retail sale licenses. Therefore, the non-eligible consumers have to purchase electricity energy from these distribution companies.

There are 21 distribution regions in Turkey. Only Kayseri distribution region has been operated by a partially private company for a longer time. While 20 of other distribution regions were a part of TEDAS until 2008, 8 of have been privatized and privatization processes of other distribution regions is going on. Whereas privatization of all these 20 distribution companies/regions by 31 July 2006 was determined as the main target at "Electricity Sector Reform and Privatization Strategy Paper" (Strategy Paper) [10] accepted by High Planning Council in 2004, as mentioned, the privatization of the first region could be realized in 2008.

Privatization of distribution companies has been implemented using a Transfer of Operation Rights (TOOR) backed Share Sale (TSS) model. According to this model, the investor is the sole owner of the shares of the distribution company which is the unique licensee for the distribution of the electricity in the designated region but does not have the ownership of distribution network assets and other items that are essential for the operation of distribution assets. The ownership of these assets remains with TEDAS. The investor, though its shares in the distribution company, however, is granted the right to operate the distribution assets pursuant to a TOOR agreement with TEDAS [11].

In Turkey, electricity is generated by state-owned Electricity Generation Co. (EUAS), their subsidiaries, affiliates, partnerships; the companies having Build-Operate-Transfer (BOT), Build-Operate-Own (BOO) and TOOR contracts; other private generation companies and autoproducers.

Within the framework of Strategy Paper, EUAS was split into 6 portfolio generation groups which hold hydroelectric, lignite and gas fired plants. While the aim of Strategy Paper was to privatize these 6 groups, none of them have been privatized yet. However, the control of major hydro plants (which are not expected to be privatized) will be under EUAS.

There are 54 private wholesale license holders in Turkish electricity market as of 02 August 2010 [12]. In addition, Turkish Electricity Wholesale Co. (TETAS), a state-owned company, owns a wholesale license. Due to existing BOT, BOO and TOOR contracts between government and private parties, the power purchase obligations from private generators constitute a "stranded cost" element in the new system defined with the enactment of EML. The government, via TETAS, undertakes responsibility for recovering these contracts as a type of vesting contracts. Mitigating stranded costs by offsetting them via bundling high existing contract prices with low cost (hydro) generators resulting in an acceptable average price has been the preferred method [9].

The current structure of the market is demonstrated in Fig. 1. Electricity trading is performed by bilateral contracting and in balancing and settlement market. EUAS sells electricity to TETAS whereas EUAS's subsidiaries, affiliates, partnerships and portfolio generation groups sell electricity to distribution companies. The power plants generating electricity within the framework of BOT, BOO and TOOR contracts sell all of their electricity generation to TETAS. TETAS purchasing electricity from these plants and EUAS

[2] An English version of EML can be found at the EMRA website (www.epdk.org.tr).

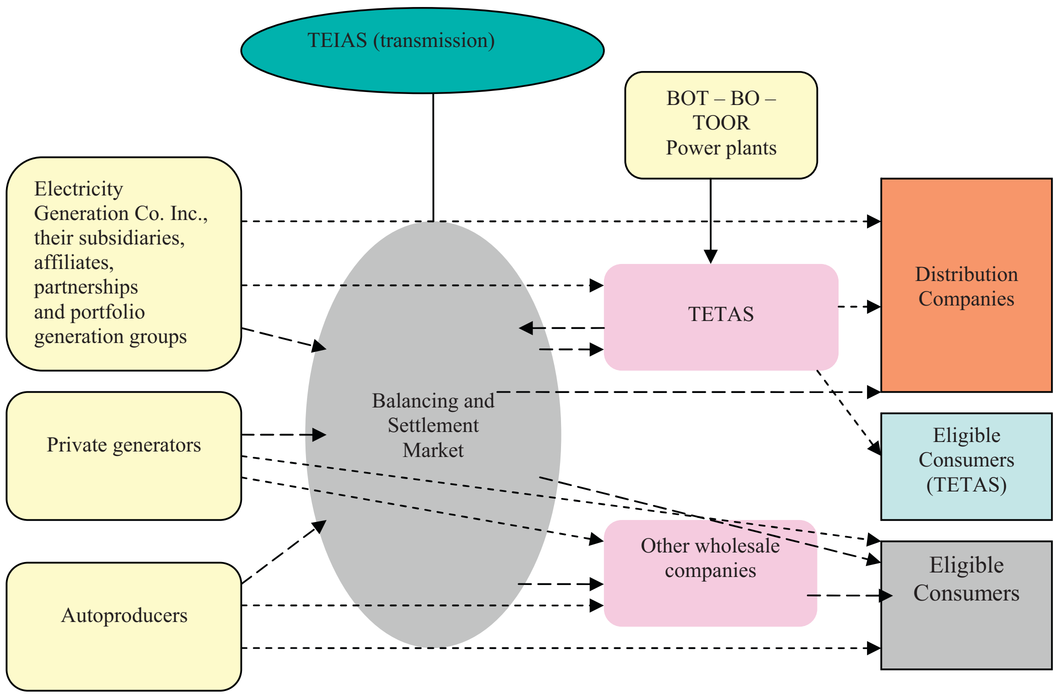


Fig. 1. A breakdown of current Turkish electricity market.

provides electricity to distribution companies. Besides, TETAS supplies electricity to some eligible consumers to whom it supplied electricity before the enactment of EML. However, if these eligible consumers cancel their contracts, they lose the right to purchase electricity from TETAS.

Private generators provide electricity to eligible consumers or wholesale companies by bilateral contracting. Autoproducers have the right to sell 50% of their generation in the market and they sell electricity to eligible consumers or wholesale companies.

Generators, autoproducers, wholesale companies and retail companies (who are currently distribution companies) trade electricity in the balancing and settlement market. TETAS participates in the balancing and settlement market in behalf of the plants having BOT, BOO and TOOR contracts.

Although EML allows the distribution companies to purchase energy directly from private generators or wholesale companies, currently there are not any contracts between distribution companies and private suppliers. Besides, the volume of the bilateral contracts between private generators and wholesale companies or eligible consumers is very low. Almost all of the electricity generated by private generators is sold in the balancing and settlement market. Therefore, many of the wholesale companies have only limited trade activities.

2.2. An overview of the performance of the Turkish electricity market

Total installed capacity of electricity is 45,050 MW as of 7 April 2010 [13]. As shown in Table 1, the share of EUAS and its affiliates in total installed capacity is approximately 54% showing the weight of state-owned companies in electricity generation. Total installed capacity of the plants having TOR, BOO and BOT contracts is 20.4%. Although these plants are owned by private sector, since they sell their electricity to only TETAS within their long-term contracts, they do not perform their activities as participants of competitive market. Therefore, only approximately 25.3% of the installed capacity is owned by the private actors participating in competitive market.

Table 1
Installed capacity of electricity (MW) (as 7 April 2010).

Companies	MW	Share (%)
EUAS	20,369	45.2
EUAS's affiliates	3834	8.5
TOR plants	650	1.4
BOO plants	6102	13.5
BOT plants	2439	5.4
Mobile plants	263	0.6
Private plants	7752	17.2
Autoproducers	3641	8.1
Total	45,050	100

Source: TEIAS (2010) (teias.gov.tr 07/04/2010).

The share of natural gas as primary source in total electricity generation is 49.7% whereas its share in total installed capacity is 32.5% (see Table 2). Although total thermal capacity is 65.3%, total generation by thermal power plants is 82.7% of total generation proving that Turkey's electricity generation mainly depends on thermal plants. Even though the share of wind power plants is very small, recently there is an increasing trend of building new wind generators by private companies.

Total network loss including transmission and distribution losses is 14.4% according to 2008 numbers where transmission

Table 2
Installed capacity and generation of electricity (MW) based on primary resources.

	Installed capacity (07/04/2010)		Generation (2008)	
Primary Sources	(MW)	Share (%)	GWh	Share (%)
Fuel-oil	1772	3.9	7209	3.6
Coal	2256	5	15,858	8
Lignite	8140	18.1	41,858	21.1
Natural gas	14,656	32.5	98,685	49.7
Total thermal	29,428	65.3	164,139	82.7
Hydro	14,617	32.4	33,270	16.8
Wind + geothermal	1006	2.2	1009	0.5
Total	45,050	100	198,418	100

Source: TEIAS (2010) (teias.gov.tr 07/04/2010).

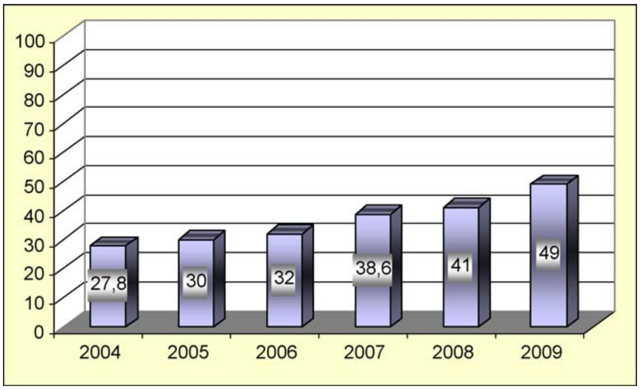


Fig. 2. Opening rate of Turkish electricity market (%).

Table 3
Concentration in Turkish electricity market[a].

Calculation method	Generator groups	HHI
1	EUAS + EUAS's affiliates + TETAS Private generation companies Autoproducers	6495
2	EUAS + EUAS's affiliates TETAS Private generation companies Autoproducers	3910
3	EUAS + EUAS's affiliates TETAS Portfolio generation groups (6) Kemerköy Private generation companies Autoproducers	1135

[a] Calculated according to the capacities of producers in March 2009.

loss is 2.3% and distribution loss is 12.1% including technical and non-technical losses [13]. This level of loss is high according to international comparisons. Hence, one of the main objectives of the reform process is to reduce to loss ratio especially to OECD levels.

2.3. Market opening and concentration level

One of the main objectives of the electricity reform process is to let all consumers choose their suppliers. In other words, EML aims to define a market where eventually 100% of consumers will choose their suppliers and the rate of market opening will be 100%. Currently, the consumers who have the right to choose their suppliers are defined as "eligible consumers".

As demonstrated in Fig. 2 market opening rate reached 49% in 2009 indicating the consumers whose total consumption is 49% of total electricity consumption are free to choose their providers. Although the market opening rate reached 49% in 2009, number of the consumers purchasing electricity energy directly from suppliers was still very low. There are two main reasons for that situation. Firstly, the price constituted in balancing and settlement market is more attractive for generators than the prices of bilateral contracts. Therefore generators prefer selling the energy at balancing and settlement market. Secondly, since the regulated energy prices of regional distribution companies are lower, the consumers prefer purchasing energy from those companies. However, it should be noted that the volume of bilateral contracts between the sellers and buyers has been increased in 2010 following the constitution of new market structure and decreasing prices in the balancing and settlement market. Yet, that volume is not so high.

Concept of market power is very important in analyzing competition in electricity industry. Carlton and Perloff [14] define market power as the ability of a firm to set prices profitably above competitive levels. Market share and market concentration, level of entry and exit, level of vertical integration, pricing and profitability are some determinants of market power. A market is called a concentrated market if it has small number of firms and these firms have large market shares. While concentration is not the sole indicator of market power, it is generally accepted as one of the best indicators of market power. High concentration may be a significant clue for market power.

As mentioned in Section 2.2, the pioneers of electricity generation in Turkey are state-owned companies. The share of installed capacity of free private generators competing in the market and autoproducers in total installed capacity is approximately 25%.

Since the plants having TOO, BOO and BOT contracts sell all of the electricity they generated to state-owned company TETAS in the context of long-term contracts, their activities cannot be assessed as free market activities. The electricity generated by EUAS, affiliates of EUAS and under control of TETAS constitutes approximately 80% of total generation.

Concentration in Turkish electricity market is shown in Table 3. Total capacity of state-owned generation and the capacity under control of TETAS are taken as a whole in the first calculation. The Herfindahl-Hirschmann Index (HHI)[3] is calculated based on this capacity and the share of all private generator companies and autoproducers. TETAS and state-owned generators are differentiated in the second calculation. In the third calculation, portfolio generation groups and Kemerköy power plant are separated from EUAS and its affiliates to determine the concentration level if these plants are privatized. Whereas the HHI is very high if it is calculated according to first and second calculation, the concentration level is medium (1135) when it is determined by third calculation. Hence, even if all these portfolio generation groups are privatized, an efficient monitoring of Turkish electricity market will be crucial.

3. Turkish balancing and settlement market

The final structure of Turkish electricity market is expected to consist of 5 sub-markets: (1) bilateral contracts market between the market participants, (2) an organized day-ahead market, (3) a real-time system balancing and operational mechanism, (4) an organized market for financially settled electricity contracts and (5) one or more organized markets for procurement of ancillary services [15].

Currently Turkish electricity market consists of bilateral contracts market and balancing and settlement market. The balancing and settlement market which functioned from 1 August 2006 to 30 November 2009 was a transitory market. Participants of transitory balancing and settlement market were generation licensees, autoproducer licensees, wholesale licensees and retail licensees. Two state-owned units had significant roles for operation of the market. National Load Dispatch Center (NLDC) which is under the body of TEIAS was the unit responsible for real time balancing of electricity supply and demand whereas Market Financial Settlement Center (MFSC), another unit under the body of TEIAS, was responsible for the financial settlement of the system.

Participants of balancing system submitted bid and offer prices for each settlement period[4] twice a month. In addition, they daily presented notifications including information regarding available

[3] HHI is calculated as sum of squares of firms' market shares. An index value above 1800 is accepted to show a highly concentrated market. An index value between 1000 and 1800 implies a moderately concentrated market whereas an index value which is lower than 1000 means an unconcentrated market.

[4] There were 3 settlement periods in the transitory balancing market: daytime (06:00–17:00), peak (17:00–22:00) and night (22:00–06:00).

Table 4
Structure of transitory, current and planned balancing and settlement mechanism.

	Transitory	Current	Final structure
Bilateral contracts market	Yes	Yes	Yes
Day-ahead operation	Day-ahead planning by NLDC	Day-ahead planning by NLDC	Day-ahead market
Real time balancing	Yes	Yes	Yes
Balancing entities	Minimum 20 MW installed capacity	No limit	No limit
Balance responsibility	No	Yes	Yes
Bid types	Hourly bids	Hourly, flexible and block bids	Hourly, flexible and block bids
Frequency of bid price submits	Twice a month (for each settlement period)	Every day (for each hour)	Every day (for each hour)
Demand-side participation	No	Yes	Yes
Financial forwards market	No	No	Yes

capacity, generation schedules and minimum stable generation level for every hour of the following day. NLDC evaluated these bids reckoning transmission and distribution constraints, technical constraints of balancing system entities and bid and offer prices. The parties increased or decreased their generation following instructions of NLDC.

There were two types of instructions given by NLDC for upward/downward regulation within the transitory balancing and settlement market. The value of the instruction tag was 0 for instructions issued for balancing purposes and it was 1 for all other instructions. The price of last accepted bid with a 0 instruction tag constituted the hourly system marginal price. A monthly system imbalance price for each settlement period was calculated as weighted average of hourly system marginal prices. MFSC used system imbalance prices while settlement of market participants.

The new balancing and settlement market has begun to operate on 1 December 2009. The new structure of balancing and settlement market is accepted as a two-step structure. In the first step the market consists of a day-ahead planning mechanism and a balancing power market while in the second step it finally will consist of a day-ahead market and a balancing power market. Balancing power market is the organized wholesale electricity market, where the reserve capacity, obtained by the change in output power within 15 min, is sold or purchased, to serve the purpose of real-time balancing of demand and supply. Balancing power market is operated by NLDC.

Day-ahead market is planned as the organized wholesale electricity market for purchase and sale transactions of electricity to be delivered in the day ahead on the basis of settlement period. It will be operated by MFSC. On the other hand, day-ahead planning is defined as the actions carried out in order to balance the foreseen hourly demand regarding the following day on the day ahead until when day-ahead market will be initiated. It is operated by MFSC, as well. Day-ahead market is expected to become a part of the market mechanism in the beginning of 2011. Table 4 displays some properties of the transitory, current and final balancing and settlement markets.

In the new market mechanism up-regulation or down-regulation instructions are separated into three according to their purposes: the instructions issued for balancing purposes are named as 0 (zero)-tagged instructions and the instructions to resolve system constraints are named as 1-tagged instructions. In addition, the tag value is 2 for instructions given within the scope of ancillary services.

Another change introduced by new regulation is the concept of trade zone. A trade zone is defined as smallest topological transmission system area where large scale transmission constraints are expected on the transmission system connection points that constitute the borders of these zones. When there are not system transmission constraints the unconstraint market clearing price will be the price of all country. However, if envisaged flow quantities between zones are more than the available transmission capacities that are reserved for day ahead market, different day-ahead prices for each trade zone and for each hour will be determined such that the transmission constraints between zones are removed. NLDC will be responsible for determining trade zones. Nevertheless, it is expected that trade zones will not come into force in near future.

4. Price constitution in temporary balancing and settlement market

The evolution of system imbalance prices which were calculated as weighted average of hourly system marginal prices since the beginning of implementation of the market is displayed in Fig. 3. The prices shown in the figure are generally higher than the regulated electricity energy prices. Since the eligible customers always have the right to purchase electricity by regulated prices from distribution companies and the regulated prices were lower than system imbalance prices they generally purchased energy from distribution companies. As a result of the same reason private generators preferred selling energy in balancing and settlement market.

Marginal price system is implemented in the balancing and settlement market. In other words, the price of the last accepted bid constitutes the hourly price. Therefore, theoretically, the bidders should offer the prices reflecting their marginal costs. If they offer prices lower than their marginal costs and the price of the hour is lower than their marginal cost the firms will lose money. On the other hand, if they bid the price higher than their marginal cost and the hourly price is between their marginal cost and their bid value, their bid will be rejected and they will miss the opportunity of making profit from that unit.

If the bidders notice that the volume of upward or downward regulations are not determined properly and they have the chance of making more profit by bidding higher prices or some artificial volumes, they will deviate from bidding on their marginal prices. Besides, if the behaviors of the market operator or the system operator do not reflect that they are careful about ensuring a sound and competitive market, that approach pushes the bidders to act strategically.

In this regard, the market structure and prices constituted in the transitory balancing and settlement market are analyzed and the opportunities that encourage bidders to deviate from marginal prices are examined and evaluated in the following sub-sections. First of all, if the instructions are given in a manner reflecting their real purposes is investigated. Then, it is examined whether there are some arbitrage possibilities pushing the market participants to bid without caring about their marginal costs. Finally, it is briefly examined if there is a relationship between reserve margin and system marginal prices.

4.1. Distribution of instructions according to their tag values

As explained before, there were two types of instructions for upward/downward regulation within the transitory balancing and settlement market. The value of the instruction tag was 0 for

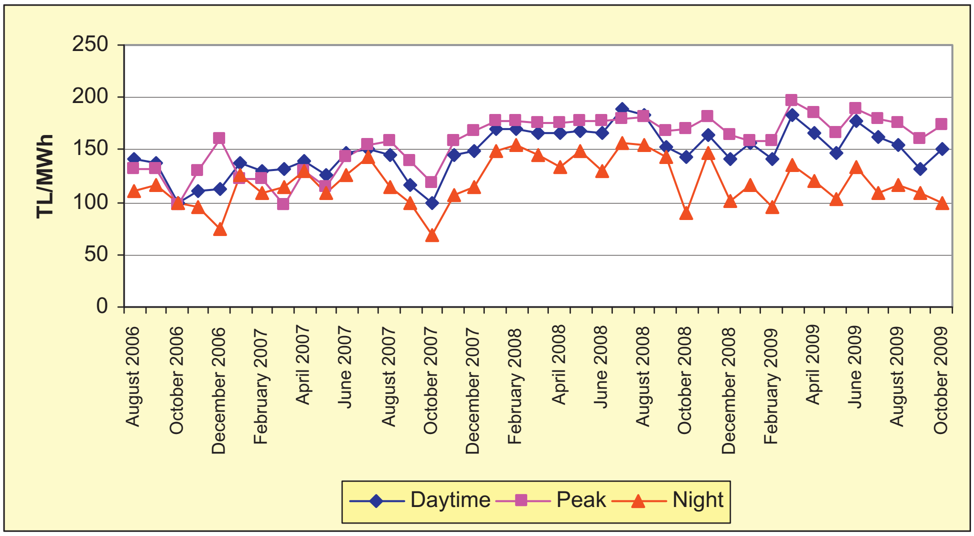


Fig. 3. System imbalance prices.

Source: TEIAS (2010).

instructions issued for balancing purposes and it was 1 for all other instructions. It is also mentioned that system imbalance price was calculated as weighted average of hourly system marginal prices which were determined as the price of last accepted bid with an 0 instruction tag. Therefore, system imbalance price only included the prices of bids which were instructed by a 0 tag value meaning the instructions whose tag values were 1 are not a part of system imbalance price.

In the planning period of the transitory balancing and settlement regulation the instructions with a 1 tag value were designed for only the instructions related with constraint management. Hence, the volume of that kind of instructions was envisaged to be very low. However, as shown in Figs. 4 and 5 the volume of 1 tagged instructions is very high. Even in some months the volume of 1 tagged instructions is ten times of 0 tagged instructions. Since the system imbalance price only includes 0 tagged instructions, it may be claimed that the high volume of 1 tagged instructions hinders the constitution of an imbalance price reflecting real value of imbalances.

The extra price arisen from 1 tagged instructions which are not included in system marginal prices were paid by generators according to their settlement supply values. Therefore, even if the costs of 1 tagged instructions were not included in hourly prices, they were important parts of the cost of generators meaning they would reflect that cost into their bid and offer prices.

4.2. An investigation on arbitrage possibilities

As mentioned in the third section, financial settlement of market participants in the transitional balancing and settlement market was based on system imbalance prices which were separately determined for all three settlement periods.

As known, daytime settlement period includes the hours between 06:00 and 17:00, peak period includes the hours between 17:00 and 22:00 whereas night time period includes the hours between 22:00 and 06:00. However, while observing the demand structure in the Turkish electricity market, it is seen that the settlement periods do not include homogenous hours. That is, in transitional balancing and settlement market, in some hours in a period demand was high enough leading to higher marginal prices while low marginal prices were realized as a result of lower demand in some other hours within the same period.

The average hourly demand for 2008 is demonstrated as an example in Fig. 6. The figure shows that although the hour 04:00–05:00 and the hour 22:00–23:00 are in the same settlement period the demand characteristics of these two hours are totally different. Whereas the demand in 22:00–23:00 is approximately as higher as the demand in peak period, 04:00–05:00 is one of the hours having substantially low demand. Hence, the first hour generally has higher marginal prices while the second has lower marginal prices. As a result of determination of system imbalance price as weighted average of the system marginal prices in the same period, many generators have the opportunity to take the advantage of the differences between the hours. Especially, if for some part of a settlement period up-regulation and for the other part down-regulation instructions are given, the participants have the possibility to try to increase their gains. Besides, it motivates the generators to offer their bids strategically.

Table 5 presents an example for expressing the arbitrage possibility. Night settlement period is taken as the period and a market participant generator assumed with 100 MWh capacity. It is assumed that the generator's generation schedule is 70 MWh for first 3 h, 90 MWh for fourth hour and 100 MWh for last 4 h. As the generator knows that the demand and marginal price will be lower in late night hours as a result of low demand, it enters high generation schedules for the late hours. Since demand is high, the generator takes up-regulation instructions for first 3 h and down-regulation instructions for the last 5 h. The generator gets the system imbalance price for its generation amount shown in its daily generation schedule. It gets 120 TL (system imbalance price) for the total 800 MWh daily generation (70 MWh for the first hour, 70 MWh for the second hour, etc.) as scheduled day-ahead. It gets the hourly system marginal prices for the amount it generates due to up-regulation instructions. For instance, it gets 180 TL/MWh for its 30 MWh generation realized as a result of up-regulation instructions given by the system operator for the first hour (22:00–23:00). On the other hand, it pays the system marginal price for the amount it does not generate due to down-regulation instructions. It pays 100 TL/MWh for 10 MWh it does not generate because of instructions for the hour 01:00–02:00. In the following hours, respectively, it pays 60 TL/MWh for 30 MWh, 50 TL/MWh for 40 MWh, 40 TL/MWh for 40 MWh and 40 TL/MWh for 40 MWh. That is, for example, for the hour 04:00–05:00 the generator purchases 40 MWh energy for 40 TL/MWh which it guaranteed to sell

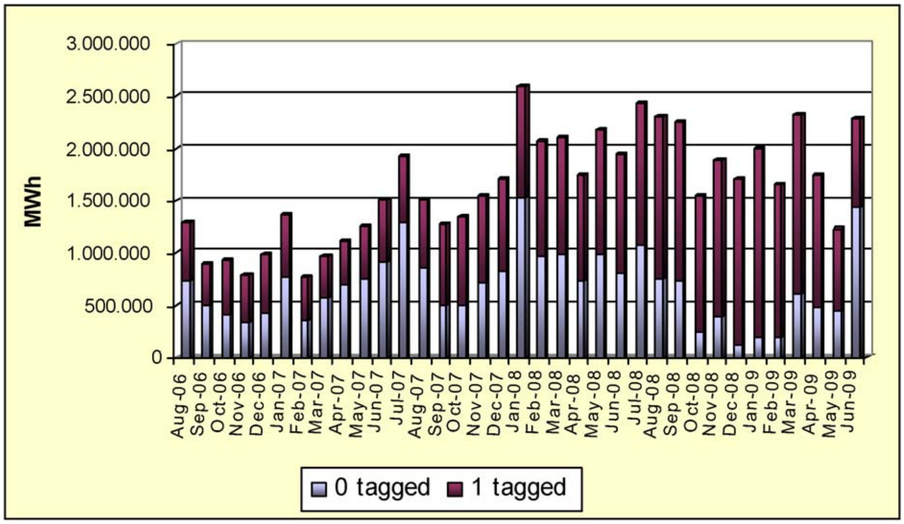


Fig. 4. Distribution of up-ward regulation instructions according to their tag values.

Source: TEIAS (2010).

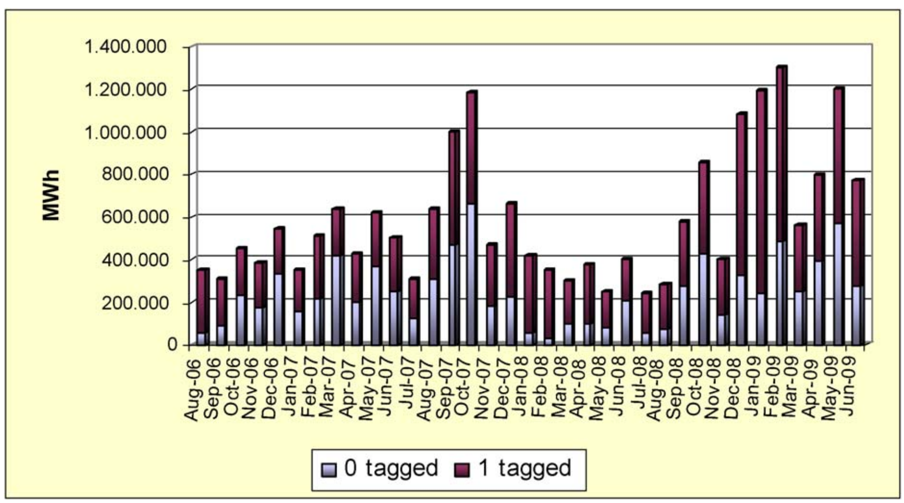


Fig. 5. Distribution of down-ward regulation instructions according to their tag values.

Source: TEIAS (2010).

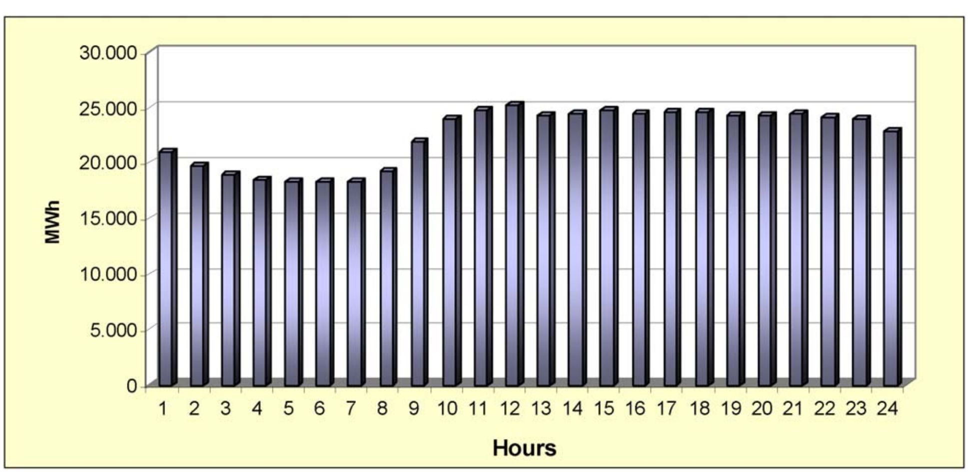


Fig. 6. Hourly average of electricity demand in 2008.

Source: NLDC (2009).

Table 5
An example showing arbitrage by a generator.

Hour	Daily generation schedule (MWh)	Amount of up-regulation (MWh)	Amount of down-regulation (MWh)	System imbalance price (TL)	Hourly system marginal price (TL)	Amount of arbitrage (TL)
22:00–23:00	70	30	0	120	180	
23:00–00:00	70	20	0	120	170	
00:00–01:00	70	20	0	120	150	
01:00–02:00	90	0	10	120	100	200
02:00–03:00	100	0	30	120	60	1800
03:00–04:00	100	0	40	120	50	2800
04:00–05:00	100	0	40	120	40	3200
05:00–06:00	100	0	40	120	40	3200

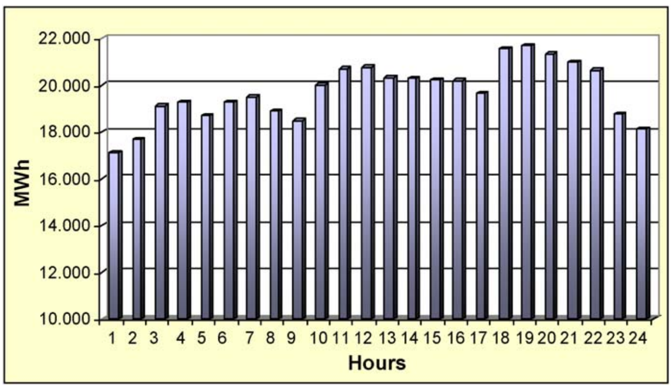


Fig. 7. Hourly average of daily generation schedules (January–February 2009).

for 120 TL/MWh before. Therefore it earns extra 80 TL per MWh, and 3200 TL for the total energy it is instructed to not produce.

The system in the transitional balancing and settlement market stimulated some participants to behave as shown in the example since they might earn extra money without generating anything. Actually, there were many practices verifying that the situation reflected in the example was exercised in the balancing and settlement market. As shown in Fig. 7, many private generators increased their generation schedule for the last hours of the night time period.

The main reason why the participants could make such an arbitrage was the settlement system based on periods but not hours. The differences between characteristics of the hours in the same period deepened the problems. If the hourly system was adopted, the main spur for notifying strategic schedules would be removed.

4.3. Is there a relationship between reserve margin and system marginal prices?

A reverse relationship is expected to occur between prices and the gap between available capacity and forecasted demand in well-functioning electricity markets. That is, when the difference between available capacity and forecasted demand is high, a lower system marginal price is expected while when the difference between available capacity and forecasted demand is low a higher system marginal price is expected.

This relationship had been observed in Turkish balancing and settlement market until the end of 2007. However, this relationship disappeared since the end of 2007 within the transitional mechanism. Fig. 8 is an example showing the disappeared relationship between prices and the ratio of forecasted demand to available capacity. Hence, that is another clue showing that the ability of the transitional Turkish balancing and settlement market to reflect the real imbalance prices has declined.

4.4. Will the new market design solve the problems?

Only one system marginal price was constituted for each hour in the transitional balancing and settlement mechanism without taking consideration of day-ahead or real-time imbalances of the participants. However, within the new market structure the prices for day-ahead balancing and real time balancing are separated. While the hourly prices were calculated day ahead for real time imbalances in the transitory market, now they are calculated after the related hour in the new market. Therefore, we think that the prices constituted in the new market structure may be more powerful to reflect the real cost of imbalances to be a signal for market participants. Besides, the volume of 1 tagged-instructions is expected to substantially decrease as a result of both the calculation of hourly prices after the related hour and their new definition stating that they can only be instructed for the purpose of system constraint management. These developments will be helpful to consist of prices having signal properties for investors, as well.

The arbitrage possibilities handled in Section 4.2 are expected to disappear as a result of financial settlement on hourly prices. This method of settlement will compel the generators to notify their optimum schedules and help to form a more healthy settlement. Nevertheless, new kinds of arbitrages may occur as a result of other market dynamics. For instance, one provision of EML states that private distribution companies may purchase electricity from generation company or companies those they own or affiliated with, with the price not exceeding the country average wholesale price. Since the country average wholesale price is not calculated hourly, it is higher than the hourly day-ahead prices at night when total demand is low. So, it precipitates an inefficient allocation by motivating the distribution companies to buy energy by higher prices from the generation companies they have or they are affiliated with when the hourly day-ahead prices are expected to be low.

It has been mentioned that the transitional Turkish balancing and settlement market was not so effective in constituting prices reflecting the margin between supply and demand. We think that the main source of this situation is again improperly tagged instructions. Since the weight of instructions with 1 tag is expected to decrease in new market mechanism the prices will substantially be determined in the market. As a consequence, prices which reflect the gap between supply and demand will be able to constitute.

Another positive development ensured by the new design is demand side participation. If participation of demand side is obtained as envisaged, it may be beneficial to mitigate price fluctuations. Furthermore, we think that the new system includes inherent properties that may take part in leading bilateral contracts to increase. Since the price will be separated as day-ahead price or real time price the prices generators will face may be lower in day-ahead.

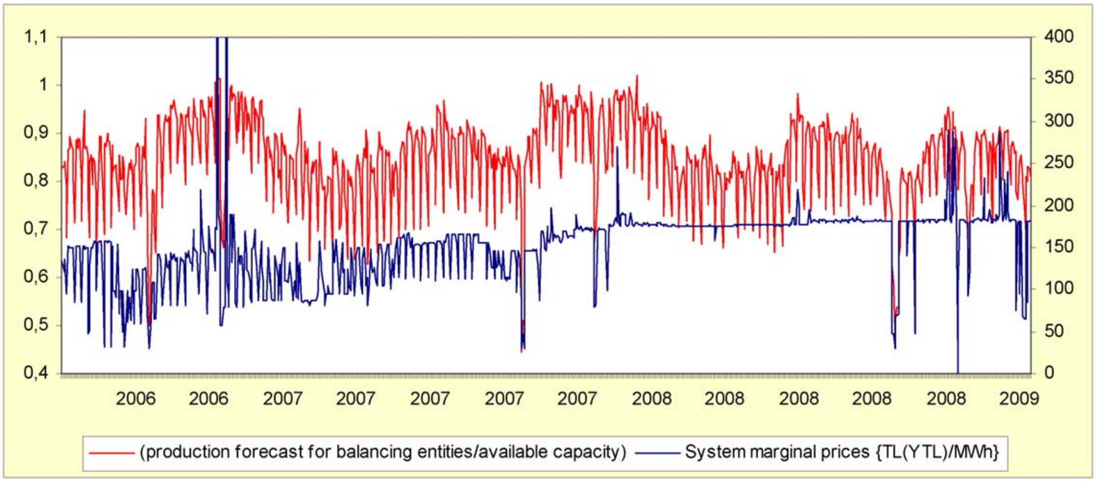


Fig. 8. Production forecast for balancing entities/available capacity and system marginal prices for the hour 17:00–18:00 (01/08/2006–06/02/2009).

5. Policy recommendations and concluding remarks

It is accepted within the context of EML that the aim of the restructuring process is to form an electricity market based on bilateral contracts signed between market participants. Market opening rate is approximately 50% in 2009 meaning consumers using half of the electricity energy have the right to choose their providers. However, the adopted balancing system is not sufficient alone to realize this object since a competitive market for wholesale trade is constituted whereas the competition in retail sale is so limited. Almost all of the prices are regulated by EMRA. The retail firms (which currently are only distribution companies) sell the energy by adding a constant profit margin to the cost of the energy. Therefore, they are not interested in decreasing the costs by signing bilateral contracts. Even if they aimed to decrease costs by bargaining, there is not enough capacity of private generators to meet the energy needed by eligible consumers or distribution companies. In this regard, we think that new retail sale firms should be allowed to perform in the market, the limit for being an eligible customer should be decreased and the privatization of publicly owned plants should be realized to help retailers or eligible consumers to be able to negotiate for purchasing low-cost energy in the market. However, the privatization of generators should be realized in accordance with the purpose of not creating one or more generation companies having market power. Besides, all the actions should be implemented simultaneously to overcome the challenges created by structural problems.

The legislation regulating the movements of eligible consumers also should be determined properly. Today, eligible consumers may purchase energy within bilateral contracts or from distribution companies by accepting not to use the rights of eligible consumers. Distribution companies are obliged to supply energy to that kind of consumers. Therefore eligible consumers frequently change their situation following the differences between the spot market prices and regulated prices. That strategy produces undesirable results affecting the market negatively. Hence, a well-designed mechanism should be implemented in addition to enhanced supplier alternatives.

Although the economic crisis has highly affected Turkish economy, it has offered some opportunities for the electricity market. The probability that Turkey would face supply problems was high as a result of a higher level of increase in demand than the increase in supply. Due to the economic crisis the total electricity consumption has decreased and the electricity supply crisis has at least postponed. In this framework, if the new market mechanism is ensured to function properly and to produce healthy price signals for investment decisions, it may be helpful in increasing installed capacity and mitigating the expected supply problem.

The responsible organization for the financial settlement of balancing and settlement market participants is MFSC which is under the body of TEIAS. That does not seem as a problem at the first glance. However, the weight of the publicly owned participants in the market is very high. In addition, their relations with TEIAS sometimes produce significant problems. For example, if MFSC cannot pay the charge deserved by the private participants on time, it should pay some additive fine to cover financial risks of the market participants. On the other hand, in the past when public entities postponed paying for their debts to MFSC they did not have to pay additive fine since both parties were under the control of state-owned companies. In summary, this situation evokes financial problems. Besides, TEIAS, many generators and many distribution companies are under the control of MENR. They have to obey the orders given by the ministry implying that they generally cannot pursue policies in order to maximize their benefits. Taking into consideration all these situations, establishment of a joint organization by the participation of TEIAS, companies displaying activity in the market, financial institutions, related governmental institutions etc. for settlement of the transactions realized in the market may be helpful to eliminate these types of problems.

An explicit agenda expressing deadlines for the steps required to achieve envisaged market structure has not been established since the adoption of EML. The negative reflection of this situation has created uncertainties and sometimes negative effects of the uncertainties have been observed in the market. Therefore, the new balancing and settlement mechanism should be implemented properly without deviating from the determined agenda to let it give smooth signals for the market participants in order to ensure sustainability and stability of the market mechanism.

Effective market monitoring and fast adjustments following problems and distortions are very crucial for a market. Nevertheless, the monitoring mechanism is not clearly defined in Turkish electricity market. The behaviors of market participants should be consistently assessed by related organizations to be able to conceive whether the market is vulnerable to manipulative behaviors. Within this context, the new system presents an opportunity to found a well-functioning monitoring mechanism whose necessity is obvious.

To conclude, a government can directly perform electricity market activities or it can let the private parties perform in the market. It is obvious that Turkey has chosen the second option, entered

into a restructuring process and implemented some policies consistent with this option. However, it may be stated that the current market structure, the results of balancing and settlement system and the level of investment are not consistent with the purposes of the restructuring process. Since the continuing changes, confusions and inconsistencies between the policies regarding the market create uncertainties, the policy instabilities are accepted as the main reasons for failure of the objectives. If these instabilities and inconsistencies are solved and the roadmap is clearly defined, Turkey may have the opportunity to achieve its goals about her electricity market. It should be kept in mind that even if the objectives of the EML do not constitute a panacea for the market, a market full of uncertainties is more hazardous for Turkish electricity industry.

References

[1] Sioshansi FP. Electricity market reform: what have we learned? What have we gained? The Electricity Journal 2006;19:70–83.
[2] Jamasb T, Mota R, Newbery D, Pollit M. Electricity sector reform in developing countries: a survey of empirical evidence on determinants and performance, The Cambridge-MIT Institute, CMI Working Paper 47; 2004.
[3] IEA (International Energy Agency (IEA). Electricity market reform: an IEA handbook, Paris, France; 1999.
[4] MFA (Ministry of Foreign Affairs). Turkey's Energy Strategy; 2008. Available at http://www.mfa.gov.tr/data/DISPOLITIKA/Turkeys_Energy_Strategy_February 2008.pdf.
[5] Hepbasli A. Development and restructuring of Turkey's electricity sector: a review. Renewable and Sustainable Energy Reviews 2005;9:311–43.
[6] Özkıvrak Ö. Electricity restructuring in Turkey. Energy Policy 2005;33: 1339–50.
[7] Cetin T, Oguz F. The politics of regulation in the Turkish electricity market. Energy Policy 2007;35:1761–70.
[8] Erdogdu E. Regulatory reform in Turkish energy industry: an analysis. Energy Policy 2007;35:984–93.
[9] Bagdadioglu N, Odyakmaz N. Turkish electricity reform. Utilities Policy 2009;17:144–52.
[10] Strategy Paper, Electricity Sector Reform and Privatization Strategy Paper, Privatization Administration; 2004. Available at www.oib.gov.tr.
[11] Lazard, Privatization of Turkey's electricity distribution industry (Teaser); 2007. Available at www.oib.gov.tr.
[12] Energy Market Regulatory Authority (EMRA); 2010. www.epdk.org.tr/lisanssorgu/elektriklisanssorgu.htm [accessed 02.08.10].
[13] Turkish Electricity Transmission Company (TEIAS); 2010. www.teias.gov.tr.
[14] Carlton DW, Perloff JM. Modern industrial organization. 4th ed. USA: Pearson Addison Wesley; 2005.
[15] Erdogdu E. A paper on the unsettled question of Turkish electricity market: balancing and settlement system (Part 1). Applied Energy 2010;87: 251–8.